

NOTES ON THE ARCHITECTURE, NESTING HABITS, AND
LIFE HISTORIES OF AUSTRALIAN ARANEIDÆ,
BASED ON SPECIMENS IN THE AUSTRALIAN
MUSEUM.

By W. J. RAINBOW, F.L.S., F.E.S., Entomologist.

(Plates lxii.-lxiv.; Figs. 13-15.)

PART VII.—ENTELEGYNÆ (*Continued*).

Family ARGIOPIDÆ (= EPEIRIDÆ, *Auct.*).

Sub-family ARGIOPINÆ.

This sub-family is not only the largest of the family of which it forms part, but contains some of the commonest, and most familiar of all spiders. It is the sedentary, orb-weaving species that are the first to attract the attention of the casual observer or amateur collector. The reason for this is obvious, for not only are many of the species large and more or less striking in appearance but, with the exception of a few aberrant forms, construct orbicular webs in prominent situations. Missionaries and travellers in out-of-the-way places, who are good enough to think of museums or arachnological students, when making collections, invariably "bag" large numbers of Argiopidæ—often duplicating a species many times over—and little of aught else. In fact, so numerous are arboreal spiders in such collections, that one is often inclined to think that amateur collectors ignored the fact that there were such things as ground-roving species.

In Australia, the Argiopinæ are represented by the following groups: Argiopeæ, Cyrtophoreæ, Arachnureæ, Cycloseæ, Mangoreæ, Araneæ, Cærostreæ, Gasteracanthæ, Anepsieæ, Cyrtarachneæ, Glyptocranieæ, Poltyeæ, Celeniæ, Arcyeæ, Dolophoneæ, and Anapeæ.

The spiders included in the first of these groups are easily distinguished. The cephalothorax is very flat, rarely longer than broad; *pars cephalica* is truncated in front, relatively short and straight, and has the segmental grooves well-defined laterally, but indistinct or effaced posteriorly; *pars thoracica* is rounded laterally, the radial and median transverse grooves are distinct;

usually the cephalothorax is thickly clothed with a silky, silvery-white pubescence. Amongst those species in which the cephalothorax is longer than wide are *Argiope protensa*, L.K., and those species described by myself as *A. extensa*, *A. pallida*, *A. gracilis*, and *A. bullocki*. The posterior row of eyes are strongly procurved, and are usually the largest of the group; the median pair are in an almost straight line, poised upon a tubercular eminence, and are closer together than are those of the posterior pair; the lateral eyes are contiguous, and are poised on tubercles; of these latter the anterior eye is much smaller than its neighbour. The *epigynum* is, with a few exceptions, either a rounded or transverse elliptical depression divided by a strongly arched, longitudinal process. In the genus *Argiope*, Aud. in Sav., the females are remarkable for their exquisite beauty. *A. atherea*, Walck., = *A. regalis*, L.K., and *A. æmula*, Walck., = *A. magnifica*, L.K., are familiar, and brilliantly coloured Australian examples. Speaking of the latter, Workman¹ says:—

“When living this is a very beautiful spider, the colours being most brilliant. It has certainly the power (possessed by several other tropical spiders) of turning quite dark when disturbed. I imagine it is able to do so by raising and depressing the hairy covering of the body.”

Both *A. atherea* and *A. æmula* are widely distributed, the former, which is popularly known as the “Cris-cross” and “St. Andrew’s Cross” spider, occurs both in New Guinea and Australia, and, although a tropical species, has been recorded as far south as Wollongong²; the latter species ranges through the Malaysian Archipelago, New Guinea and Northern Queensland.

Compared with the females those of the opposite sex are veritable pigmies, and are much more soberly tinted. As with the Nephilinae so with this sub-family, the males live on the upper edge of the web, and subsist upon the smaller insects that have been ensnared, and which are too insignificant to attract the attention of the female.

Two genera constitute the group Argiopeæ, namely, *Argiope*, Aud. in Sav., and *Gea*, C. Koch, and both occur in Australia. The range of the former has been defined as “Orbis utriusque reg. trop. et subtrop. rarius temper. ;” and the latter: “Africa

¹Workman—Spiders, i.; Malaysian Spiders, 1896, p. 27.

²L. Koch—Arach. Austr., i., 1871, p. 44.

trop. occid. (*africana* E. Sim.); Asia trop. (*spinipes* C. Koch); Malaisia; Papuasias; Nova-Hollandia et Polynesia; Amer. sept. calid. et Antillæ (*heptagon* Hentz)."³

The webs of *A. æmula* and *A. etherea*, according to Workman's description and figure are much alike.⁴ The orbicular portion varies from fifteen ins. to seventeen ins. in diameter, and is composed of from twenty-five to forty-eight rays; the inner spiral has from six to nine turns; the free zone measures about one inch; and the outer spiral has from twenty-five to fifty-six turns. At the centre of the web, and extending from the inner lines of the outer spiral right across the free zone, there are two distinct ribbons of white silk which meet at the centre, cross each other, and so produce the figure of a St. Andrew's Cross. Sometimes the ribbons extend well into the inner rings of the outer spiral, but each ribbon is always zig-zaged in outline. Other species also weave a zig-zag ribbon of silk (in fact this feature is peculiar to the webs of these orb-weavers), but in some instances the ribbon is a single one, and is placed perpendicularly, in others it takes the form of a more or less round ring, much like the ribbons or *stabilimenta* in the webs of some exotic Uloboridae. None of our Australian Argiopinæ, so far as I have been able to observe, make what Dr. McCook describes as a central shield, but it is quite possible that some of our native species—at any rate the more typical forms—may do so. Speaking of this in connection with the American Argiopinæ, McCook says:—

"The peculiarity which first strikes the observer is the oval shield of white silk which covers the hub. This is thickest and closest in the centre, and grows thinner and more open towards the margin, where it gradually merges into the radii which are attached to it. In the adult spider it is usually about two inches long by one and a half wide. Attached to the shield above and below, and extending upward and downward between two radii, is a zigzag ribbon of white silk, an inch or more long and one-fourth of an inch or more wide. It traverses the whole central space, and extends downward about two inches until it is lost in the spirals of the lower half of the orb."⁵

From the time when the young *Argiope* spreads its first orbicular snare, the zigzag ribbon is present, but it is always much more highly developed in the webs of adults. The question

³Simon—Hist. Nat. Araignées, 2nd ed., i., 1892, p. 769.

⁴Workman—*Loc. cit.*, p. 27, fig. *h*.

⁵McCook—American Spiders and their Spinning Work, 1889, i., p. 97, figs. 52 and 89.

naturally arises as to the reason for the presence of this ribbon. It cannot be for special protection, because the web is usually built in an open space, where owing to the animal's colour and the conspicuous position it takes up at the centre of its web, it can be easily seen. A bird or predatory insect in quest of such prey (for the Argiopids are often found in wasps' nests) would not be likely to miss it. McCook expressed the opinion that the ribbon is introduced for the purpose of strengthening the shield, but since all the species do not construct a shield or screen, that cannot fully explain the reason for its presence. Personally, I am inclined to the opinion that it acts as a support to the central space and hub and also that it materially assists in bearing the weight of the spider's body; where a shield is constructed, the zigzag ribbon would, doubtless, be beneficial. The central space and hub of the web of *Argiope* is very fragile and delicate, whilst the spider, in proportion to it, especially when gravid, is large and heavy.

The spider, like all orb-weaving species (with the exception of those which roll or fold leaves, whose habits will be referred to later on) when at rest takes up her position at the centre or hub, and always head downwards; but the Argiopeæ differ from all other Argiopidæ in the disposition of their legs, for whereas orb-weavers in general spread their eight ambulatory limbs well out, *Argiope*, on the other hand, always rests with hers arranged in pairs, well extended, and so approximated that they describe the letter X. *A. atherea* and *A. amula* always dispose theirs in pairs over the zigzag ribbons forming the St. Andrew cross design.

The general structure of an *Argiope* web is very similar to that of the typical orb-weaver; it varies in dimension, according to the size of the architect, and sometimes according to environment; but whatever the size or surroundings may be, the zigzag band of silk on *stabilimentum* is always present, hence the naturalist can always tell when he sees one of these snares (even though the architect be absent) the genus to which the latter belonged. It is interesting to note the *modus operandi* of working-in the ribbon. The main structure of the web with its supports consisting of outer lines or groups, radii and concentric rings having been completed, *A. atherea* drops down to a point a little below the centre of the snare and takes up its position between two rays running in an oblique direction towards the central point of the hub; this she ascends, discharging silk from her spinnerets as she does so, and as all are at work voiding simultaneously, it follows that a broad ribbon is the result. The zigzag effect is caused by the animal swinging its abdomen from side to side as

it climbs. This process is repeated on each side of the hub, both above and below, until the work is completed.

The web is always suspended in a more or less vertical position, with the ordinary framework and supporting lines, but if the locality be one that is exposed to strong gusts of wind, an irregular or retitelarian web may be spun, as a means of protection, on either side of the orb. I have not infrequently seen such in the scrub land around Botany Bay. When a retitelarian web is constructed in conjunction with the orb, the lines of the former are continued both above and below the latter. McCook has noted the same feature in connection with American spiders of the genus *Argiope*. This retitelarian web being built in front of each face of the orb, has been termed by the American author quoted "protective wings," and he suggests that they may be a protection against hostile insects or other enemies hovering around the web, the slightest touch of which on one or other of the protecting wings would instantly telegraph the presence of an undesirable visitor, and so allow the legitimate tenant of the web time to drop to the ground and seek cover.

The cocoon of *Argiope atherea* is much like that of *Nephila ventricosa*, mihi, figured and described in my last paper upon this subject.⁶ Usually it is found at the end of a twig of some shrub hard by the maker's orb-web. Occasionally I have seen one attached to the tops of the blades of some coarse grass or at the tips of brackens, and sometimes amongst the stems of the latter. The ova-sac is completely surrounded by a mass of loose flocculent yellowish silk, and is composed of a thin, crisp, papery substance; it is flask-like in shape, and perfectly impervious to water. Within this papery shell there is another sac, more or less bag-shaped, and this contains the eggs. Unlike the outer or flask-shaped sac, this bag is soft and flexible. Interposed between the outer walls of the latter, and the inner walls of the flask-like structure there is a quantity of soft, loose, flocculent silk, which completely surrounds the bag. Thus, it will be seen, the eggs are admirably provided for in the way of protection, not only against heavy rains, but predatory foes such as birds, lizards and mice. They do not wholly escape, however,—nothing in nature ever does—for certain Hymenopterous insects, such as Ichneumon flies, sometimes succeed in piercing the entire mass with their long ovipositors. The eggs are of a glossy, translucent, yellowish tint. The cocoon of *A. atherea* may be looked for during the autumn months, and the spiderlings in spring.

⁶Rainbow—Aust. Mus. Rec., vi., 5, 1907, pp. 336-7, fig. 53.

Gea, C. Koch=*Ebaea*, L. Koch, occurs in "Africa trop. occid. (*africana* E. Sim.); Asia trop. (*spinipes* C. Koch); Malaisia; Papuasia; Nova-Hollandia et Polynesia; Amer. sept. calid. et Antille (*heptagon* Hentz)."⁷ Notwithstanding its geographical range, the genus is a small one, only about a dozen species being known; of these, six have been described from Indo-China, one from Australia (*G. theridioides*, L. K., Port Mackay); one from New Guinea (*G. bituberculata*, Thor.); and one (*G. praeincta*, L. K.) from Samoa. The individuals are all small, but there is little difference in size between the sexes; if anything, the males are slightly the smaller.

The architecture of only one species (*G. festiva*, Thor.⁸) has been described and figured. It is a small and closely fabricated orb, erected perpendicularly, and measuring from five to six inches in diameter; rays, 48-56; inner spiral, 7-11 turns; free zone, 1 in.; outer spiral, 32-58 turns. This web, which had no zigzag ribbon (*stabilimentum*), was noted at Singapore. Nothing is known of the spider's cocooning habits.

The section *Cyrtophoreæ* includes only one genus, *Cyrtophora*, E. Sim., and its distribution is: "Orbis utriusque reg. tropicæ et subtropicæ."⁹ Our species *C. hirta*, L.K., *C. parvasia*, L.K., and *C. sculptilis*, L.K., were each originally recorded from Bowen. According to Simon, the latter Australian species is a synonym of *C. citricola*, Forsk., a form that has been recorded from the Mediterranean region, tropical, East and West Africa, South Africa, Madagascar and neighbouring islands, Yemen, India, Ceylon, and Singapore.

The webs of *Cyrtophora* differ from the characteristic snares of the family to which it belongs. Examples of these have been described by both Workman (*C. citricola*¹⁰) and McCook (*C. basilica*,¹¹ McCook). The orb is of a very primitive type, and takes the form of a dome, which latter consists of a large number of radii and spirals, all closely woven; the latter extend entirely and with equal regularity to the summit. Immediately below the dome and supported by the radii of the latter is a horizontal sheet or floor composed of lines irregularly cast. Both above and below dome and floor, and surrounding both, is a complicated reticularian structure. Primitive though it be, this form of snare

⁷Simon—*Loc. cit.*, pp. 769-770.

⁸Workman—*Loc. cit.*, p. 30, fig. *h*.

⁹Simon—*Loc. cit.*, p. 775.

¹⁰Workman—*Loc. cit.*, p. 32, fig. *h*.

¹¹McCook—*Loc. cit.*, p. 164, fig. 154.

is distinctly beautiful. Considering their beauty, it is a pity these structures are so fragile; and also that when kept in captivity the architects persistently decline to give an example of their architectural skill. I have kept many species for observation at different times, but none have ever favoured me with a web such as they fabricate in nature. Doubtless the surroundings were not favourable.

Dr. R. H. Pulleine, of Adelaide, informs me that he has often noted a web of a South Australian spider exactly like that described by McCook in respect of *C. basilica*.

The section Arachnureæ, like the preceding, includes only one genus, *Arachnura*, Vinson, and it abounds in "Afric trop., orient., contin. et insul.; India; Malasia; N.-Hollandia et N.-Zelandia."¹² It has not yet been recorded from Papua, but it is only reasonable to suppose that it exists there. Simon says he possesses an undescribed form from the Philippines.

These spiders are not large, but they are of striking form. Our species are *A. higginsi* and *A. caudata*, Bradl. I have collected the former at Waterfall, National Park, and at Guildford, and have also seen specimens from Tasmania. Mr. W. Bullock has collected it at Parkville near Scone, and Mrs. Ross at Armidale. Originally it was taken at Darling Downs, Queensland.

The cephalothorax is flat, and the grooves at the junction of the cephalic and thoracic segments, as well as the median transverse thoracic groove, are deep and strongly defined; the abdomen overhangs the base of the cephalothorax, and at its anterior extremity is deeply indented; it is long and attenuated, the posterior extremity tapering so as to appear like a tail, which latter is terminated with a spur-like process, but the projections forming it are small and, in point of size, unequal. The males of our species are unknown; Simon, however, observed one in Ceylon, probably the male of *A. scorpionoides*, Vinson, which was only about one millimetre in length, whilst the female measured 15, so that the disparity between the sexes is very great.

The webs of *A. higginsi* observed by me at Waterfall and Guildford were perpendicular, of the normal orbicular form, and about fifteen inches in diameter. When disturbed, this species drops from its web and hangs suspended by its spinnerets to a fine thread of silk. In this position it would certainly escape the persecution of predatory foes, since both in colour and appearance it resembles a dead rolled leaf. If greatly alarmed, this spider will drop to the ground and feign death. On one occasion when

¹²Simon—*Loc. cit.*, p. 777.

collecting in the bush, I came across an individual of this species amongst the fallen sticks and leaves that constitute the forest *débris*, and had it not been that I observed a slight movement in one of its legs, probably due to disturbing the rubbish, it would have escaped my notice.

It would seem, however, that the orbicular form of snare is not constant with *Arachnura*. A New Zealand species discovered by Dr. Llewellyn Powell “spins only a few irregular threads, crossing each other at various places, among twigs or small branches and stems of herbaceous plants, very similar to spiders of the genus *Theridion*.”¹³ Simon’s observations of the webs of species of this genus at Manilla¹⁴ agree with mine as detailed above in respect of *A. higginsii*.

Four genera are included in the next section, the Cycloseæ, but only one of them, *Cyclosa*, Menge, is included in our fauna. The range of this genus is “*Orbis totius reg. temp. et calidæ*.”¹⁵

Epeira rhombocephala, Thor., from Cape York, and *E. vallata*, Keys., from Rockhampton, together with a number of Malaysian, Papuan, and Polynesian forms, have been transferred by Simon from *Aranens* (*Eperia*) to the genus *Cyclosa*. Of the two Australian forms quoted, *Cyclosa vallata* is alone known to me. It is a very small species, measuring only about three and a half millimetres in length; the abdomen is longer than broad, strongly arched, and has two large tubercles on its upper surface. The species included in the genus are very variable, and the abdomen may be ovate, obtusely rhomboidal, subquadrate, or shortly ovate and subglobose. The webs of *Cyclosa* are orbicular, and are fabricated in an almost vertical position, the spirals are numerous and very closely woven; a *stabilimentum* is present, but this latter varies with the different species. The ova are deposited in a series of cocoons, which are sometimes concurrent with or constitute the *stabilimentum*.

The species described by me, together with its web and cocoons, as *Epeira pallida*, must be transferred to the genus *Cyclosa*.¹⁶

Mangoreæ is a section to which no Australian species have as yet been assigned, but seeing that one genus, *Lobetina*, Simon, included in it is represented both in New Guinea (*L. opaciceps*,

¹³Cambridge—Ann. Mag. Nat. Hist., (4), vi., 1870, p. 116.

¹⁴Simon—*Loc. cit.*, p. 777.

¹⁵Simon—*Loc. cit.*, p. 783.

¹⁶Rainbow—Proc. Linn. Soc. N. S. Wales, xxiii., 1897, p. 514, pl. xvii., fig. 1, and pp. 534 and 535, fig. 1.

Simon), and also in New Zealand (*L. plagata*, Simon), it is only natural to suppose that it will sooner or later be found to exist upon the mainland of the Commonwealth. The range of this genus is "N. Guinea et N. Zealandia."¹⁷

Notwithstanding the fact that the section Araneæ comprises only five genera, three of which are represented in Australia, it nevertheless includes one, *Aranæus*, Clerck, which probably embraces more species than any other included in this branch of the fauna. About one thousand species are known to naturalists, and many still await description. The series or groups into which the genus may be systematically divided have been exhaustively treated by Simon in his masterly work, "Histoire Naturelle des Araignées," and to this every arachnological student, anxious to acquire something more than a superficial knowledge of his subject, must turn.

The genus *Aranæus* (= *Epeira*, Auct.) is represented in all parts of the habitable globe; many of the species are widely distributed, and some are exceedingly common and variable. Simon defines the range of the genus as "Orbis totius regiones omnes."¹⁸

Amongst trees, between bushes, amidst coarse herbage, in gardens and orchards from early spring to late autumn these spiders may be found. The webs are orbicular, but varying degrees of regularity and skill may be noted in the structure, and in the habits of the species. Some construct a perfect orb, the size of which depends largely upon the species; but it may also be influenced by situation or surroundings. There is usually a "nest" or resting-place at the extremity of some spur or branchlet, formed by bringing a number of leaves together and binding them into position with silk. This retreat, when found, is always connected with the hub of the web by what McCook terms a "trap-line." The retreat is used as a refuge from insectivorous foes or shelter in wet or excessively windy weather. Some orb-webs are imperfect: that is to say, they do not always form a complete circle—a sector may be wanting; some, indeed, only fabricate about half an orb. One of the most extraordinary webs I have ever seen I saw at Mosman. This was some years ago, before this favourite suburb of Sydney was built upon as it is now, and when it was a beauty spot as Nature designed it. This interesting snare was stretched between three large native shrubs, the positions of which described a triangle. For the want of a better term this may be described as a *double* web, to differentiate

¹⁷Simon—*Loc. cit.*, p. 795.

¹⁸Simon—*Loc. cit.*, p. 829.

it from the *compound* web to be described later on. The main body of the mesh consisted of the typical orb, with the customary outer lines or guys, but at the back, and running down the centre, a semi-orb had been built. This latter may not have been the work of the architect of the complete orb; it may have been purely adventitious. I am the more convinced that this is so, because I have carefully examined many webs since, and have not found another example, and I certainly think I should if it had been the result of instinct. At the time I discovered this web I sought for the architect, but it had evidently made good its escape, and was probably simulating death amongst rubbish, or hiding in some quiet nook or corner. Occasionally orb webs may be met with that have two or three more or less horizontal lines fixed to the hub and some adjacent object. These lines communicate with a tubular or leafy retreat and, as they are drawn tightly, cause the snare to be somewhat depressed at the centre.

Frequently huge orbicular snares are erected at considerable heights. I have recorded one such that I saw on the South Head Road, Belle View Hill, Sydney,¹⁹ the topmost transverse line of which ran from a tree on one side of the road to a telegraph post on the other. By a well directed stone, I succeeded in bringing the builder down, and it proved to be the common *Araneus herione*, L.K. It is remarkable, considering how fragile these structures are, the amount of wind-pressure they can bear; this is due, no doubt, to their elasticity. The *compound* web, to which I referred above, consists of an orb, and an elaborate and complicated reticularian snare, which latter is sometimes at the rear of the web, sometimes at both sides of it, and sometimes continued both above and below (fig. 13) much like some of the snares constructed by certain species of *Argiope*.

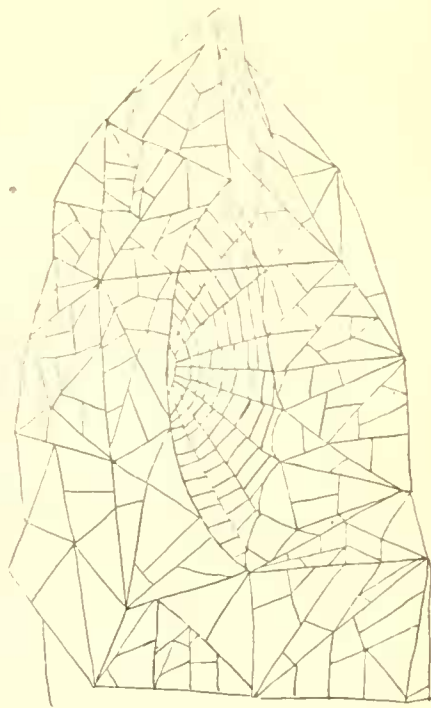


Fig. 13. Compound Web.

¹⁹Rainbow—*Loc. cit.*, p. 531.

All these orb-weaving spiders have the habit of enshrouding superfluous prey, or such as are powerful and likely to do damage to the snare, with silk. As the victim struggles, the spider pays out a line of silk, which not only becomes entangled in legs and wings, but is made to closely and tightly encircle the insect's body, and so render it helpless. Insects thus enclosed may be seen hanging on the outskirts of a web.

It is really remarkable what differences are found to exist in the common orb web, when one takes the trouble to make and compare notes. The old school of naturalists contented themselves by simply noting the fact that spiders of certain genera constructed geometric webs, and these were generally accepted as being round or wheel-like. But, as a matter of fact, all orb-webs are not round, nor is the hub always strictly at the centre. The radial lines may be, and often are, longer above the hub than below, and sometimes *vice versa*; then again the number of radii varies: there may be only seventeen of these, or more than fifty. I have counted in different webs 17, 22, 24, 25, 26, 32, 36, and 52 radii; but the differences are not specific. Three webs made by one species, *Araneus productus*, L.K., among the shrubs in my garden, had 26, 32, and 36 respectively. Another interesting feature is that it is not necessarily the largest web that has the greatest number of radii; indeed, I have most frequently found that the smaller webs made by the diminutive species of *Araneus* have not only more radii, but also a greater number of spirals than those made by their larger congeners. The snares of *A. productus*, *A. heroine*, and *A. brisbanæ*, L.K., may each vary, and often do, both in size, number of radii, number of spirals, and supporting lines or guy-ropes, but all these variations are due to peculiarities of site. The webs of *Araneus* are almost invariably parallel to the plane of the horizon, but frequently exigencies of construction compel such an arrangement of foundation lines as to deflect the snare more or less sharply from the vertical plane.

One of the commonest spiders around Sydney is *Araneus wagneri*, mihi²⁰; a species which, together with its web, nest, ova-sac and other details of its life-history, I described and figured some years ago. Another species common around Paramatta and Liverpool, *A. sylvicola*, mihi,²¹ makes, it is interesting to note, a web like that of the former species; moreover, its nest consists of a rolled leaf, and its ova-sac a folded one,

²⁰Rainbow—*Loc. cit.*, xvii., 1896, p. 325, pl. xix., figs. 2, 2a, 2b, 2c, 2d, and p. 335.

²¹Rainbow—*Loc. cit.*, xxiii., 1897, p. 518, pl. xvii., figs. 4, 4a, and p. 536.

exactly like *A. wagneri*. Indeed, the life-history of these two widely distinct species appears to be exactly similar in every detail.

A. wagneri is apparently far from being particular as to the material it uses for its nests. At the moment of writing I have before me four examples of paper nests collected by me at Canterbury. Notwithstanding that there was no shortage of material in the shape of leaves available for nests, four individuals had actually utilised scraps of newspaper for the purpose. Two of these examples are rolled so as to form cylindrical retreats, one is in the form of an elongated cone, and the fourth is simply folded. Each of these nests have their edges held in position with silk, and the interior of the chamber lined in the usual manner with the same material. Messrs. Philip de la Garde, R.N., and J. J. Walker, R.N., each collected specimens of such paper nests made by *A. wagneri* on Garden Island, Port Jackson, so that the habit of utilising such material does not appear to be uncommon.

The cocoon of *Araneus heroine* is about an inch and a half long and half an inch wide; it is ovate, densely matted, and the silk of which it is composed is dark green. The cocoon is usually located near the extremity of a small branch, and is surrounded and held in position by an irregular network of fine lines. Both the density of the cocoon and the labyrinthine lines surrounding it must be decidedly protective. The cocoons of some spiders are penetrated by the stings of parasitic wasps, but those of many species of Argiopidæ are rendered fairly immune from attack by the defensive reticularian network that surrounds them. Within the cocoon there is, of course, the ova-sac; this latter is invariably white, of a paper-like texture, and it encloses a number of yellowish eggs surrounded by yellowish, flocculent silk. Some species of *Araneus* enclose three small ova-sacs in their cocoons.

When the time arrives for the Argiopid spiderlings to make their appearance, they cut a small opening at the apex of the cocoon, but they are probably a few days old when they do this, as they have already passed through one moult. This is proved by the fact that when a cocoon is opened numbers of cast skins are seen. In cutting their way out, they are not assisted by the mother. In fact she almost invariably dies long before the young ones make their appearance. Professor B. G. Wilder, an American naturalist, was of opinion that birds were instrumental in aiding the escape of young spiders from their cocoons, because he had observed a bird, about the size of a sparrow, pulling at a

cocoon hanging in a tree. I am doubtful if such a provision exists in Nature. My experience is that a cocoon is never designedly opened until the time is ripe for the young ones to escape, and this is controlled by the instinct of the latter. Birds do undoubtedly pull spider-cocoons and webs to pieces, but it is in order that they may line their nests with the material.

Food is not necessary to spiderlings when domiciled within the cocoon, and therefore no provision is made in this respect; and furthermore nothing in the shape of cannibalism obtains until some time, probably a week or ten days, after the young have escaped. No time is lost after escaping from the cocoon, in the fabrication of a web, but it is a common one in which every member of the community, males and females—at this stage indistinguishable—assist in constructing, and in which all have a share. This web consists of a closely woven sheet that envelopes everything within its vicinity and from which, until after the second moult, they evince no desire to wander. It is interesting to note that these sheet-webs are usually densest above the cocoon (Plate lxii.), for it is there that the majority of the infantile spider community will be found. If the web be disturbed but slightly, immense numbers of these tiny creatures will rapidly descend by means of their drop-lines (which are emitted as they fall) and hang dangling in the air. For about a fortnight the spiderlings live together gregariously, but the migratory instinct then manifests itself. Each individual that has escaped the dangers, including cannibalism, with which the life of an infant spider is beset, assumes the attitude common to the Araneidæ prior to the æronautic flight. In some species the eight legs are so spread as to describe a circle, the abdomen is then depressed and silk is voided, the animal turning round and round as it does so; in this way a “foot-basket” is made, after which the abdomen is raised, and a delicate gossamer thread is thrown out until sufficient has been voided to carry the tiny animal off. Even the calm air of a room is sufficient of itself to lift one of these animals and waft it along in its current. In the field, prior to ballooning, the young orb-weaver takes up a position, back downwards, on some of the reticularian lines, and commences to pay out silk as follows:—

First the spinnerets are brought into close contact, and the liquid silk is emitted; the spinnerets are then separated by a lateral motion, which breaks up the silk into fine filaments; on these filaments the air-current impinges, drawing them out to a length which is regulated by the will of the animal; and, on the spinnerets being again brought together, the filaments

coalesce and form a compound line.²² In flight, the animal is carried off back downwards, and its feet control and aid in spreading out the filaments, at the base of which there is, in the case of some species, a small quantity of flocculent silk which forms a kind of hammock or basket. This latter is often considerably larger than the spider. When the spider wishes to descend, it hauls in and rolls up the filaments in a tangled mass.

The orbs made by young spiders are very similar to those of the adults. They are, of course, much smaller, and have a lesser number of rays and spirals, but where there is any ornamentation, as in the case of *Argiope*, or where it is customary for a matured spider to make a nest or retreat, we find the young ones, as soon as they start constructing orbicular snares, doing exactly the same. The young of *A. wagneri* and *A. sylvicola* each roll a small leaf or piece of paper in exactly the same manner as do the adults. But after each succeeding moult, and as the animal grows, webs and nests become larger until they have attained their maximum. *A. herione* passes through eight moults or changes of skin, after which it is adult.

Amongst the synonyms of this genus Simon, with a query, includes *Heurodes*, Keys. This genus was erected by Keyserling to receive a species which he named *turrita*,²³ on account of the curious structure of its abdomen. I think, however, that Keyserling's genus should stand for the reasons stated by him. In a brief note he says:—"This genus is near to *Epeira* W., but is distinguished therefrom by its spineless legs, the high clypeus, and the great breadth of the cephalic segment in front."

Two other small genera are included in this section:—*Carepalxis*, L.K., and *Acroaspis*, Karsch. The first of these occurs in "N.-Guinea; N.-Hollandia; Amer. centr. et merid.," and the latter is restricted to "Nova-Hollandia."²⁴ Of about a dozen species assigned to *Carepalxis*, six occur in Australia. The species described by me as *Epeira coronata*²⁵ belongs to this genus. The web of *C. tuberculata*, Keys., is small, but of the normal orbicular type. *Acroaspis* contains only two species, both of which are unknown to me.

Two genera are included in the group Gasteracanthæ, namely *Gasteracantha*, Sund., and *Encyosaccus*, Simon. The range of the

²²Blackwall—Ann. Mag. Nat. Hist., xv., 1845, p. 241.

²³Keyserling—Die Arach. Austr., ii., Suppl., 1886, p. 116, pl. ix., figs. 3, 3a.

²⁴Simon—*Loc. cit.*, p. 830.

²⁵Rainbow—Proc. Linn. Soc. N. S. Wales, xxii., 1896, p. 629, pl. xlix., fig. 1.

former has been defined by Simon as "Orbis totius regiones tropicæ,"²⁶ but it also occurs in subtropical and, to a limited extent, in temperate zones: the latter genus is only found in "Brasilia: Amazonas."²⁷

About 200 species of *Gasteracantha* have been described, and these have been divided by Simon into two sections, based upon the structure of the abdomen, and the number and proportion of the spines, and these include several subgenera.²⁸

The *Gasteracantha* are easily distinguished by the abdomen, which is hard (chitinous), armed with two, four, or six spines, which vary in length, strength, and direction, and issue from different points of the margin. The abdomen is also marked on the upper surface, and sometimes underneath, with numerous symmetrically disposed cicatrose spots, varying a little in size, form, and position. These markings Cambridge designated *sigilla*, owing to their resemblance to seals impressed upon the surface. The number, distribution, and relative distinctiveness of these *sigilla* are often of assistance in the determination of the species. The males are veritable pigmies compared with the females, and differ much from the latter in respect of abdominal armature. In some species of *Gasteracantha* the abdomen is very flat, in others it is more or less arched, but whichever it may be it is always very large in proportion to the cephalothorax, and its anterior angle always overhangs the latter. The legs are always short.

The webs of *Gasteracantha* are usually constructed in open places. The species common around Sydney, *G. minax*, Thor., = *G. flavomaculata*, Keys., constructs a snare about eighteen inches in diameter; it is orbicular, vertical, and closely meshed. The rays vary in number (22 to 30) and do not meet at the centre, but are connected with a common ring. When the web is newly constructed the rays do meet, but the central extremities are afterwards cut away, thus leaving an open ring or hub. The beaded spirals commence close to the ring and continue towards the outer lines or framework. There is no *stabilimentum* present. According to McCook and Simon, some species decorate their webs with tufts of white, flossy silk, but those that I have seen in the bush around Sydney were not so ornamented. The latter author, however, says that the habit is variable with the same

²⁶Simon—*Loc. cit.*, p. 845.

²⁷Simon—*Loc. cit.*, p. 847.

²⁸Simon—*Loc. cit.*, pp. 838-843, pp. 845-847.

species. There is no retreat constructed in connection with these snares. When resting in the web a *Gasteracantha* always occupies the centre, and, as usual, rests head downwards. In such a position, owing to their colouration, they form very conspicuous objects, but their spiny armature doubtless protects them from the raids of insectivorous birds. I have seen many spiders that have been taken from the crops of the latter, but never a *Gasteracantha*.

G. minax occurs also in Queensland and Victoria. There is a common black variety of this form to which L. Koch gave the name *lugubris*, and which he regarded as a distinct species. The differences are merely those of colour, and the size and shape of the spines. Another variety to which the same author also gave specific rank is *G. minax*, var. *astrigera*. This latter variety is black only on the upper surface, whilst the former is black both above and below. Both the typical form and its melanic varieties are common in Queensland, New South Wales and Victoria.

The cocoon of *G. minax* is very variable, but very pretty. It is usually found attached to the stem of some adjacent plant, such as a weed, grass, or wild flower, and is more or less elongate in form. Usually it is bound to a stem, longitudinally, but sometimes it is pendulous. The colour varies from dark brown to golden-brown or even bright yellow, and examples vary in length from about 35 mm. to 15 mm.; of these the larger are by far the most attenuated. The cocoons are beautifully made and closely woven. Two specimens in the collection of the Museum are attached—one partly to the stem and partly to a leaf of a Flannel Flower (*Actinotus helianthi*, Labill.), and the other partly to a petal and partly to a stem of a Flannel Flower; a third example is suspended from a grass stem (Plate lxiii., figs. 1, 2, 3).

Other species recorded as occurring in Australia are: *G. fornicata*, Fab., "Neu Holland"; *G. vittata*, Thor., Port Mackay, Queensland; *G. westringii*, Keys., "Neu Holland"; *G. sacerdotalis*, L.K., Bowen and Cape York, and to these localities I now add Port Darwin; *G. suminata*, Cape York; and *G. variegata*, Walek., Bowen.

Three genera are included in the group Anepsieæ, viz., *Aspidolasius*, E. Sim., *Anepsia*, L.K., and *Paraplectanoides*, Keys. The first of these is, as far as we know at present, restricted in its range to Central America; the second, although it has not yet been recorded from Australia except in error, may, nevertheless, be reasonably expected to occur here, seeing that it is found in

“Asia merid.; Malaisia et Polynesia;”²⁹ the third, which consists of two species only, viz., *P. crassipes*, Keys., and *P. kochi*, Cambr., occurs only in “Nova Hollandia.”³⁰ Nothing is known of the habits or life-history of either of these species; in fact, no observations have been recorded as to the economy of any members of the group.

The group *Cyrtarachneæ* is a widely distributed one, and contains half-a-dozen genera, many of the species of which are striking forms. Two genera occur in Australia, viz., *Cyrtarachne*, Thor., and *Pacilopachys*, E. Sim. Of these the range of the former is “Reg. mediterr. occident.; Africa tropica occid. orient., austr. et ins.; Asia centr., merid. et orient.; Japonia; Malaisia; Nova Hollandia; and that of the latter, “Nova Hollandia et Polynesia.”³¹

In reference to their webs, Simon remarks that those that have been observed are large and very regular. I have collected several specimens of *Pacilopachys bispinosa*, Keys., around Sydney. Most of them were obtained by beating bushes over an inverted umbrella; one individual that I was fortunate enough to observe was resting on a bright green leaf, in which position it simulated, to a marvellous degree of fidelity, the excreta of a bird. Indeed I at first regarded it as such, but knowing that this habit is common with many species of the Arthropoda, I was induced to look more closely, and so detected the deception. Others who have brought me specimens, or to whom I have pointed out this habit, have confirmed my observation. The legs of the animal are short, and when it is at rest these are bunched-up closely to its sides; the abdomen is large, and its anterior extremity projects boldly over the cephalothorax; on its upper surface there are two large acuminate tubercles; these latter are dull white, and are elevated on a broad transverse field of yellow-brown, in front of which is a transverse bar of dull white; hence the colours of the animal, together with its dorsal abdominal tubercles and bunched-up legs, simulate most unmistakably the irregular mass of chalky-white and brown so characteristic of the excreta of birds. I have seen specimens of this species from the South Sea Islands and from many parts of Australia.

Cyrtarachne setosa, Keys., is another striking form, the legs and abdomen of which are armed with stout bristles. The type

²⁹Simon—*Loc. cit.*, p. 870.

³⁰Simon—*Loc. cit.*, p. 871.

³¹Simon—*Loc. cit.*, p. 880, p. 876, fig. 942.

of this species, which was collected at Sydney, was in the Godeffroy Museum, but its whereabouts now is not known.

Cyrtarachind cocoons that have been collected are described as being globose and attached to a long peduncle. Several such have been forwarded to me from time to time, but always, unfortunately, without the spider (Fig. 14).



Fig. 14. Cocoon of
Cyrtarachne sp.

Glyptocraniæ includes four genera, two of which occur in Australia, viz., *Ordgarius*, Keys., and *Dicrostichus*, E. Sim. The former occurs in "India et ins.; Taprobane (*Hobsoni* Cb.); Birmania (*sexspinosa* Th.); ins. Amboina (*clypeatus* E. Sim.); Nova Hollandia (*monstrosus* Keyserl.);"³² *Dicrostichus*, on the other hand, occurs only in "Nova Hollandia."³³

Notwithstanding its wide range, very few species of *Ordgarius* have been described. These are *O. hobsoni*, Cambr., from India and Ceylon; *O. sexspinosa*, Thor., from Burmah; *O. clypeatus*, E. Sim., from Amboina; and *O. monstrosus*, Keys., from Peak Downs, Queensland. Besides these, Simon says he has one (unnamed) in his collection from Java.

Dicrostichus includes three species and one variety, viz., *D. furcatus*, Camb., and its variety *distinctus*, mihi; also *D. caliginosus*, mihi; and *D. magnificus*, mihi.

The retitelarian web, egg-bags, and leaf-nest (the latter in the form of a *cornucopia*) have already been described and figured by me.³⁴ I now have the pleasure of figuring and describing the nest of *D. furcatus* (Plate lxiv.). The web of this species, like that of *D. magnificus*, is small and of the retitelarian type, the lines of which are closely woven amongst the leaves of the plant upon which the spider has become domiciled. On referring to the right-hand side of the plate, a little above the spider, the reader will perceive the body of a wasp which has become entailed in the outer lines of the snare. The nest or retreat is among the thick maze of leaves at the top of the plate. It is very closely and densely woven, but is not nearly so neat a structure as that made by *D. magnificus*. It will be noted on referring to the plate that the spider does not rest in its snare after the manner of other Argiopids, but with the head upwards. Some years ago

³²Simon—*Loc. cit.*, p. 885.

³³Simon—*Loc. cit.*, p. 886.

³⁴Rainbow—*Proc. Linn. Soc. N. S. Wales*, xxiii., 1897, p. 538, figs. 2 and 3.

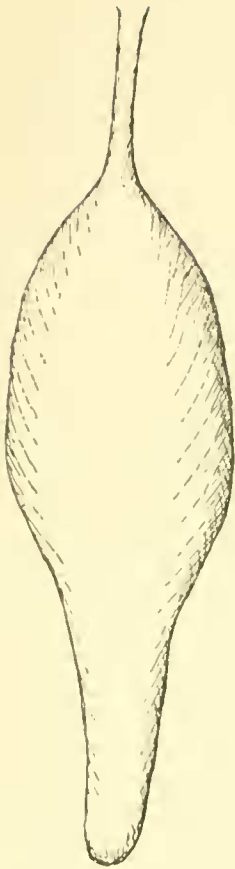


Fig. 15. Cocoon of
Dicrostichus sp.

my friend, Mr. A. G. Hamilton, gave me a photograph of *D. magnificus* with egg-bags and nest, and that spider also is shown resting head upwards.

The egg-bags of *D. furcatus* differ from those of *D. magnificus*; they are smaller, have a shorter peduncle, which latter have again flattened apical extensions, that are directed either at right or oblique angles according to the position of the objects to which they are attached. The effect of these flattened extensions is to give to the egg-bag a flask-like appearance. In other respects, both externally and internally, those now figured are similar to the ones previously described by me, and quoted above. Besides these egg-bags, there is, in the Museum collection, two others attached to a nest of leaves bound together. These are probably constructed by another species of *Dicrostichus*, but they are much larger and have a different shape. Those figured in the plate herewith are delineated at their actual size. The ova-sac figured in the text is five inches long and three inches in circumference at its widest girth (Fig. 15).

The nest and cocoons (two) of *D. furcatus* described above were collected by Mr. W. Bullock at Parkville, near Scone, and presented by him to the Trustees of the Australian Museum. Besides this we have in our collection a nest made by the same species to which four egg-bags are attached. The latter was collected at Sydney by Mr. E. D. Lee, and by him presented to the Trustees. The large one is merely labelled "New South Wales."

The group Poltyeæ contains five genera, only one of which, however, occurs in Australia, *i.e.*, *Poltya*, C. Koch, and its range is "Reg. tropicæ cunctæ Africæ, Asiæ et Oceaniæ."³⁵ Keyserling has described five species from Queensland,³⁶ and I have described two others, one from Cooktown (*P. multituberculatus*),³⁷ and one from Fremantle, W. Australia (*P. salebrosus*).³⁸ Keyserling's

³⁵Simon—*Loc. cit.*, p. 893.

³⁶Keyserling—*Die Arach. Austr.*, Suppl., 1886, pp. 123-133.

³⁷Rainbow—*Austr. Mus. Rec.*, iii., 4, 1888, p. 82, pl. xviii., figs. 2, 2a, 2b.

³⁸Rainbow—*Loc. cit.*, v., 2, 1904, p. 30, figs. 28, 29.

species are *P. laciniosus*, Peak Downs; *P. manneatus*, Peak Downs; *P. coronatus*, Cape York; *P. keyserlingi*, Gayndah; *P. bimaculatus*, Peak Downs. To the range of the latter I now add: Canley Vale, near Sydney, and Springwood, Blue Mountains.

The webs and nesting-habits of these spiders do not appear to have been observed. Usually the species are obtained from withered branches, to which their colour and form so closely harmonise. The field-note given to me by Mr. J. J. Walker, R.N., with *P. salebrosus*³⁹ agrees with those recorded by Keyserling.⁴⁰

Two genera, viz., *Celenia*, Thor., and *Taczanowskia*, Keys., are included in the group Celeniæ. The range of the former is "N. Hollandia; Tasmania; N Zealandia," but the latter occurs only in Peru and Brazil.¹¹

The spiders included in this group are decidedly abnormal—so much so, indeed, that some authors have at first regarded them as members of that very distinct family the Thomisidæ. Cambridge, for instance, founded a genus, which he named *Thlaosoma*⁴² for the family just quoted, but it is now accepted by authors as a synonym of *Celenia*, and is, as such, one of the numerous genera included in the great family Argiopidæ. All the species of *Celenia* are striking forms, and the commonest of them, *C. excavata*, L.K., and *C. (=Thlaosoma) dubium*, Cambr., are remarkable for their simulation of the excreta of birds.

Prior to receiving Simon's great work, I had, in common with others, regarded *C. excavata* and *C. dubium* as Thomisids, and in one of my early papers⁴³ in which I described the life-history, mimetic habits and egg-bags of the first named species, I so placed them. Up to the present date, five species of *Celenia* have been described from Australia and five from New Zealand. Our Australian species are: *C. kinbergi*, Thor., from "New Holland"; *C. excavata*, from Brisbane, but now known to range from N.E. Queensland to Tasmania; *C. dubia*, Cambr., New Holland (fairly common around Sydney); *C. distincta*, Cambr., "New Holland"; and *C. calotoides*, mihi, from Parkville near Scone.

In reference to *C. distincta*, I pointed out in a previous paper⁴⁴ that Cambridge founded his species upon an immature and dried

³⁹Rainbow—*Loc. cit.*, p. 31.

⁴⁰Keyserling—*Loc. cit.* pp. 125, 127, 131.

⁴¹Simon—*Loc. cit.*, pp. 597-8.

⁴²Cambridge—*Journ. Linn. Soc.*, x., 1869, p. 271.

⁴³Rainbow—*Proc. Linn. Soc. N. S. Wales*, xxii., 1896, p. 336.

⁴⁴Rainbow—*Loc. cit.*, xxvii., 1902, p. 488.

example, and that in all probability a specimen that had fallen into my hands would prove to be synonymous with the species described by Cambridge. I am still inclined to that opinion, but must await material for comparison with the type before venturing to express a decided opinion upon the matter.

The example which I regard as *C. distincta* came from Prospect, near Sydney. When discovered it was resting upon a twig, in which position it closely resembled a broken spur. Had it not been for an indiscreet movement upon its part, it would have been passed by unobserved, and so would not have been included in our collection.

The life-history and cocooning habits of *C. calotoides* was described and figured by me last year.⁴⁵ I now figure *C. excavata* and her egg-bags (Plate lxiii., fig. 4).

The young of *Celenia* disperse by "ballooning." They make "foot-baskets" and throw out filaments until the latter are sufficiently long to overcome the laws of gravitation just as do those species previously referred to in this paper.

Seven species only are included in the group Arcyæ, and these are divided into two genera, viz., *Arcys*, Walck., the range of which is "N. Hollandia et Tasmania; ins. Fidji (*brevipalpus* Karsch.); ins. N. Caledonia (*perlatus* E. Sim.); and *Archemorus* E. Sim., from Tasmania.⁴⁶

Nothing has been noted in respect of the weaving and cocooning habits of the Arcyæ. All the specimens I have collected have been taken by "beating" and "sweeping."

Arcys lancearis, Walck., ranges from Brisbane to Tasmania; *A. cornutus*, L.K., has been recorded from Rockhampton, Bowen, and Peak Downs, Queensland, and to these localities I now add, Tweed River, New South Wales; *A. alatus*, Keys., Sydney; and *A. clavatus*, Keys. In his description of the latter species, Keyserling does not state the locality from whence his type came, but concludes with a note "Museum Godeffroy." I have, however, received specimens from the Jenolan Caves District. *Archemorus* contains but one species, *A. simsoni*, E. Sim., and that comes from Tasmania.

By the comparative hardness of their abdominal integument, and the cicatrose impressions on the upper surface of the latter, spiders of the group Dolophoneæ present a somewhat superficial resemblance to the Gasteracanthids. They are not, however,

⁴⁵Rainbow—Austr. Mus. Rec., vii., 1, 1908, pp. 44-46, fig. 2.

⁴⁶Simon—*Loc. cit.*, p. 901.

armed with spines, and only two species are at present known that possess a vertical tubercle, which arises from the middle of the dorsal surface of the abdomen like a column; they are *Dolophones turrigera*, L.K., and *D. nasalis*, Butl. Generally speaking, the abdomen is flat, broad, and transversely oval or cordiform.

Two genera are included in this group, viz., *Dolophones*, Walck. = *Tholia*, L.K., and *Pitharatus*, F. Sim. The former is distributed over "Ins. Ceram; ins. Paem.; N. Hollaudia; and N. Caledonia;" and the latter "Ins. Java et pen. Malayana."⁴⁷

Of Australian species *D. testudinea*, L.K., has been recorded from Port Mackay and Bowen, but it has also been collected in New Caledonia; *D. turrigera*, L.K., from Brisbane, and to that locality I now add: Sydney, Parramatta; *D. clypeata*, L.K., Queensland; *D. noctacantha*, Walck., Sydney; *D. nasalis*, Butl., Queensland; *D. peltata*, Keys., ? locality; *D. tuberculata*, Keys., no locality given, but I have received specimens from Bungendore, New South Wales collected by Mr. A. M. Lea; *D. pilosa*, Keys., from Peak Downs, Queensland, to which I now add Antonio, near Rydal, New South Wales, collected by Mr. S. J. H. Moreau; *D. mammeata*, Keys., Australia; *D. coniferu*, Keys., from Peak Downs; and *D. simpla*, Keys., Sydney.

The locality from whence *D. clypeata* was obtained was unknown to Koch, who states at the foot of his diagnosis:—"Vaterland: ? Zwei. Exemplare in K. K. Museum zu Wien";⁴⁸ and Keyserling, in respect of his species, *D. mammeata*, vaguely records it as "Australien."⁴⁹

The webs, nests, and cocoons of *Dolophones* have not been recorded. On referring to my note-book, I find that in November, 1890, I collected a specimen of *D. testudinea* at Belle Vue Hill, Sydney, from an orbicular web.

Anapeæ is the last section into which this great family is divided. It is split up into four genera, only one of which occurs in Australia. This genus, *Chasmocephalon*, the distribution of which is "Africa max. austr.; N. Hollandia,"⁵⁰ was founded by Cambridge in 1889⁵¹ for the reception of a West Australian species which he named *neglectum*, and which is the only one of the group, so far as we know at present, occurring in Australia.

⁴⁷Simon—*Loc. cit.*, p. 904.

⁴⁸Koch.—*Die Arach. Austr.*, i., 1871, p. 24.

⁴⁹Keyserling—*Op. cit.*, Suppl., 1886, p. 109.

⁵⁰Simon—*Loc. cit.*, p. 928.

⁵¹Cambridge—*Proc. Zool. Soc.*, 1889, p. 45.

Chasmocephalon was placed by Cambridge in the family Theridiidæ, from which it has been removed to the Argyopidæ by Simon. In the introduction to his paper⁵² the Rev. O. P. Cambridge says :—“ One of the spiders described here is remarkable, not only for its minuteness, being no more than half a line in length, but for the peculiar character of its cephalothorax, in which the ordinary indented lines showing the junction of the caput and thorax are replaced by two deep oblique fissures, necessitating, along with other characters, the formation of a new genus. . . . This specimen has been in my possession for many years past, but had until lately been overlooked owing to its having been accidentally concealed among the hairs on one of the legs of a large spider received in 1864 from the Swan River.”

⁵²Cambridge—*Loc. cit.*, p. 35.